

surface is not outwardly deformed, then a user touch at the particular region in the surface 115 is preferably not recognized as a user input of the first type or the second type, but rather is recognized as a user input of a third type that is distinguishable from a user input of the first type and the second type. The user input of the third type may also be ignored. Additionally, in the Extended Cavity mode, a force applied by the user of a third rate of change, wherein the third rate is higher than the first rate but lower than the second rate, may be interpreted as a user input of a fourth type. However, any additional rate of change of force applied by the user on the particular region 113 may be detected and interpreted as any suitable type of user input.

[0051] The processor 160 may also function to automatically alter the settings of the user interface system 100. In a first example, in extremely low temperatures, it may be impossible for the displacement device 130 to modify the volume of the fluid to expand the cavity 125 and deform the particular region 113. The processor 160 may be coupled to a temperature sensor and may disable the displacement device 130 under such conditions. In a second example, in high altitude conditions (or in an airplane with reduced air pressure), it may be impossible for the displacement device 130 to modify the volume of the fluid to retract the cavity 125. The processor 160 may be coupled to a pressure sensor and may either disable the displacement device 130, or may simply adjust the volume of the fluid that is modified under such conditions.

[0052] As shown in FIGS. 21a-21d, the processor 160 may also be coupled to the display 150 such that different input graphics may be displayed under the particular region 113, and different inputs may be recognized. As an example, when the cavity 125 is in the Extended Cavity Mode, as shown in FIG. 21a, the display 150 may include an input graphic of a first type (such as a letter) and the user input on the deformation, as shown in FIG. 21b, would be of a first type (such as a letter), and the display 150 may include an input graphic of a second type (such as a number) and the user input on the deformation would be of a second type (such as a number), as shown in FIG. 21c. When the cavity 125 is in the Retracted Cavity Mode, the display 150 may further include an input graphic of a third type (such as an "enter" or "accept" input), and the user input on the sensor 140 would be of a third type (such as an "enter" or "accept" input), as shown in FIG. 21d. The processor 160 may also be coupled to the device upon which the display 150 and the user interface system 100 are used and may function to control processes carried out by the device.

[0053] The processor 160 may also function to alter the output of the display 150 to correct or adjust for any optical distortion caused by the deformation of the particular region 113. It is envisioned that, in certain applications, the size of the deformation may cause a "fish eye" effect when viewing the display 150. The processor, preferably through empirical data, may adjust the output to help correct for this distortion.

[0054] The processor 160 preferably includes a separate and remote controller for the displacement device 130, a separate and remote controller for the sensor 140, and a separate and remote controller for the display 150. The processor 160 may, however, integrally include a controller for one or more of these elements.

[0055] The processor 160 preferably performs one of the functions described above, but may also perform any combination of the functions described above or any other suitable function.

5. Second Cavity

[0056] As shown in FIG. 1, the user interface system 100 of the preferred embodiment also includes a second cavity 125. The additional cavities may be substantially identical to the cavity 125, but may also be different in construction, geometry, size, and/or any other suitable feature. Each of the plurality of cavities 125 are preferably able to outwardly deform independently from each other, allowing the user interface system 100 to be adapted to a variety of user input scenarios. Alternatively, the plurality of cavities 125 may be grouped into a plurality of portions, wherein the cavities 125 within one group will outwardly deform together. This may be applied to scenarios wherein a group of cavities 125 are assigned to a particular user input scenario, for example, as a dial pad on a mobile phone or as a QWERTY keyboard. The processor 160 preferably selectively controls the outward deformation of the particular region 113 of each cavity 125. However, any other suitable method of controlling the cavities 125 may be used.

[0057] The processor 160 preferably also selectively receives and/or interprets signals representing the presence of a force applied by a user to any cavity 125. The sensor 140 for each cavity 125 is preferably arranged in an array network that preferably communicates the location of each sensor 140 to the processor 160 to allow the processor 160 to selectively receive and/or interpret signals coming from each cavity 125. In the variation of the sensor 140 as a capacitive sensor, as shown in FIGS. 22 and 23, the array includes a first number of X-conductors 142 and a second number of Y-conductors 144. In a first variation, as shown in FIG. 22, the first number of X-conductors 142 is preferably equivalent to the number of cavities 125, wherein each X-first conductor 142 corresponds to one cavity 125, and the second number of Y-conductors 144 is preferably equivalent to the number of columns of cavities 125, wherein each Y-conductor 144 corresponds to all the cavities 125 within one column of cavities 125. In this first variation, the location of a user touch is preferably determined by detecting a change in the measured capacitance value between one X-first conductor 142 and the corresponding Y-conductor 144 for a particular cavity 125. Because each cavity 125 is associated with one X-first conductor 142, the processor 160 is able to detect the location of the cavity 125 over which the user had applied a force. In a second variation, as shown in FIG. 23, the first number of X-conductors 142 is preferably equivalent to the number of rows of cavities 125, wherein each X-first conductor 142 corresponds to all the cavities 125 within one row of cavities 125, and the second number of Y-conductors 144 is preferably equivalent to the number of columns of cavities 125, wherein each Y-conductor 144 corresponds to all the cavities 125 within one column of cavities 125. In this second variation, the location of a user touch is preferably determined by detecting a change in the measured capacitance value between one X-first conductor 142 and one Y-conductor 144. Because each cavity 125 corresponds to a different intersection of the X-conductors 142 and the Y-conductors 144, the processor 160 is able to detect the location of the cavity 125 over which the user had applied force. In a third variation, the first number of X-conductors 142 and the second number of Y-conductors 144 are both